EE292.2 **MIDTERM EXAMIN**
Electrical Engineering Lab I
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I. HEALTH AND SAFETY

Q) "Occupational Health and Safety" is concerned with the protection of workers in their employment from factors adverse to their health. **True** of **False**? _____

Q) For the purposes of Occupational Health and Safety legislation, a "supervisor" means a person who is engaged in an occupation in the service of an employer. **True** of **False**? _____

Q) For protection purposes, the resistance of the human body measured between the "perspiring hands of a worker" is considered to be:

a) 500,000Ω c) 700,000Ω
b) 1500Ω d) 100Ω

Q) When a person is exposed to an electric shock, the outcome will depend on the age, gender, skin condition, health and blood chemistry of the victim. It will also depend other factors such as the potential involved. List two other factors that could have a significant effect on the severity of the injury to the victim.

1)_____

2)_____

Q) The conduction mechanism for current flowing through the human body is generally due to microscopic "burn through" for lower voltages and normal electrical conduction for higher voltages. **True** of **False**? _____

Q) A GFCI (ground fault circuit interrupter) is a protective electrical device that effectively disconnects the load from the supply when the internal sensing circuitry detects a resistance to ground of greater than 100KΩ. **True** of **False**? _____

Q) Assume you have witnessed an electrical accident (accidental electrocution) where the victim is unconscious but still contacting the electrical source. *Briefly* describe your *first* course of action.

_____

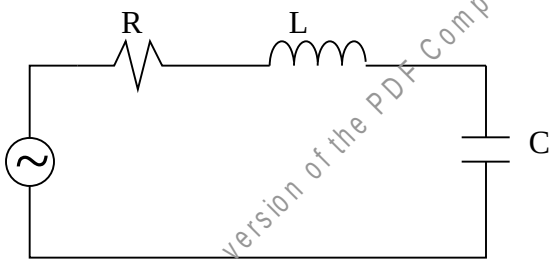
Q) The following questions pertain to the effects of electric and magnetic fields on the human body:

a) The primary biological effect for fields of both types at frequencies above approximately 1MHz is _____.

b) Indicate whether the following effects are normally a result of *electric* or *magnetic* fields:
i) Exist whenever a voltage is present but don't penetrate the body (***electric*** or ***magnetic?***)
ii) Exist whenever current flows and easily penetrate the body (***electric*** or ***magnetic?***)
iii) Induces current in the body through magnetic induction (***electric*** or ***magnetic?***)
iv) Induces current in the body due to charge buildup (***electric*** or ***magnetic?***)

II. LAB 1-5:

Question 1: In the circuit shown below, the resonant frequency is f_r=10KHz and the bandwidth is B_f=3KHz. If C=0.1μF, find the corresponding values of L and R.

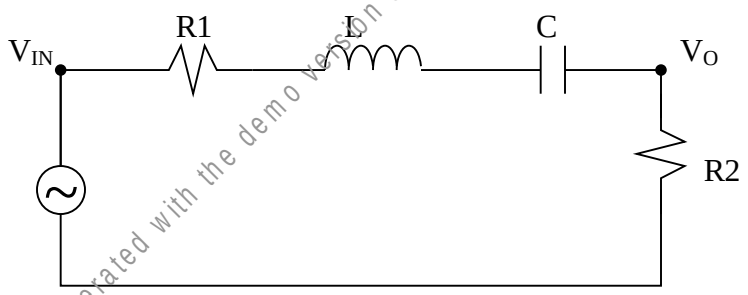


Question 2: In the circuit below, R1=40Ω, L=0.8H, C=1.25μF and R2=160Ω

a) Calculate the magnitude of the transfer function H(jω)

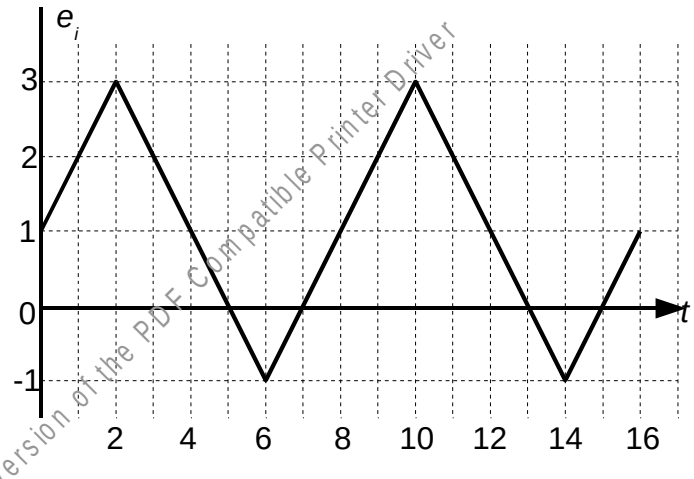
$$|H(j?)| = \frac{|V_o(j?)|}{|V_{in}(j?)|}$$

b) Find the exact value of the maximum voltage gain and the corresponding frequency in Hz
c) Find the quality factor (Q) of the circuit if the bandwidth frequency is 39.78Hz.

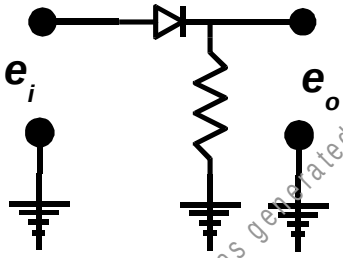


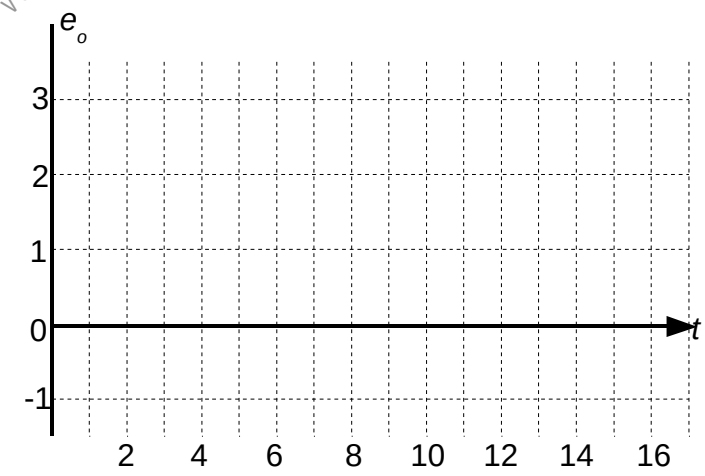
Question 3:

Sketch the output waveform, e_o, for each of the diode circuits shown below when the input waveform, e_i, is as shown at right. Assume the diodes are silicon switching type with an idealized forward biased conduction voltage drop of 0.7V and a reverse breakdown voltage greater than 100V. Further, assume that R is such that the forward current specifications of the diodes are not exceeded.



i)





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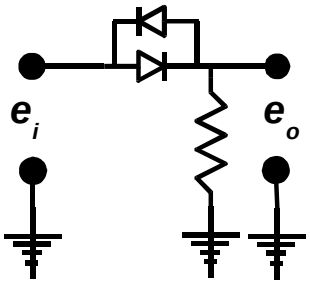
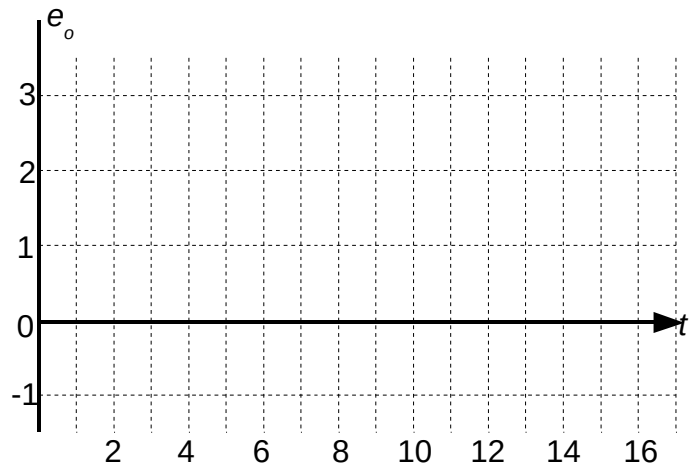
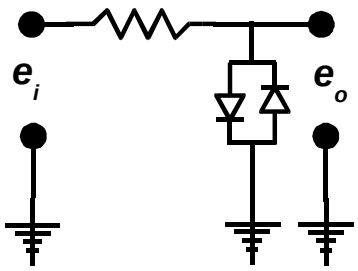
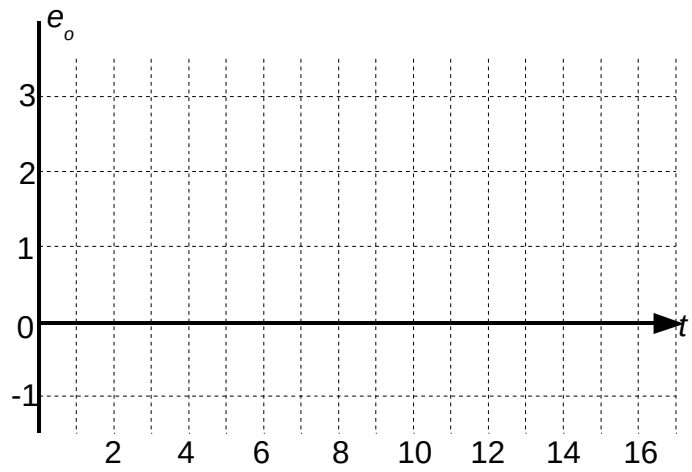




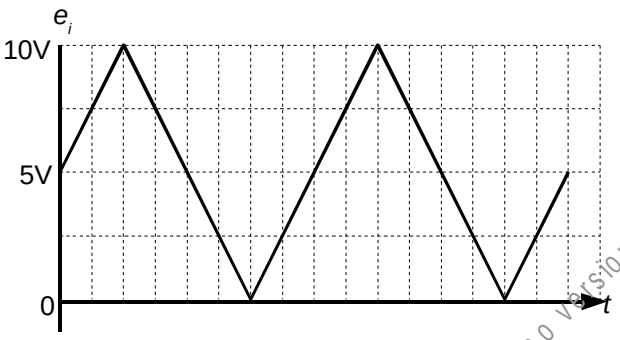
iii)

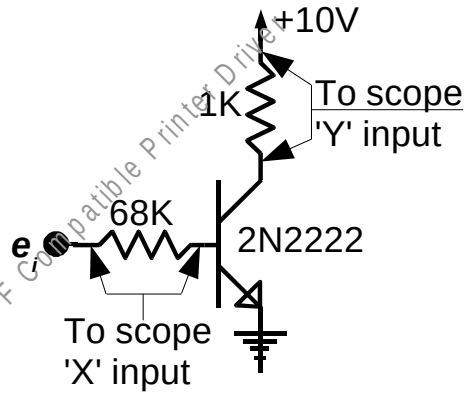




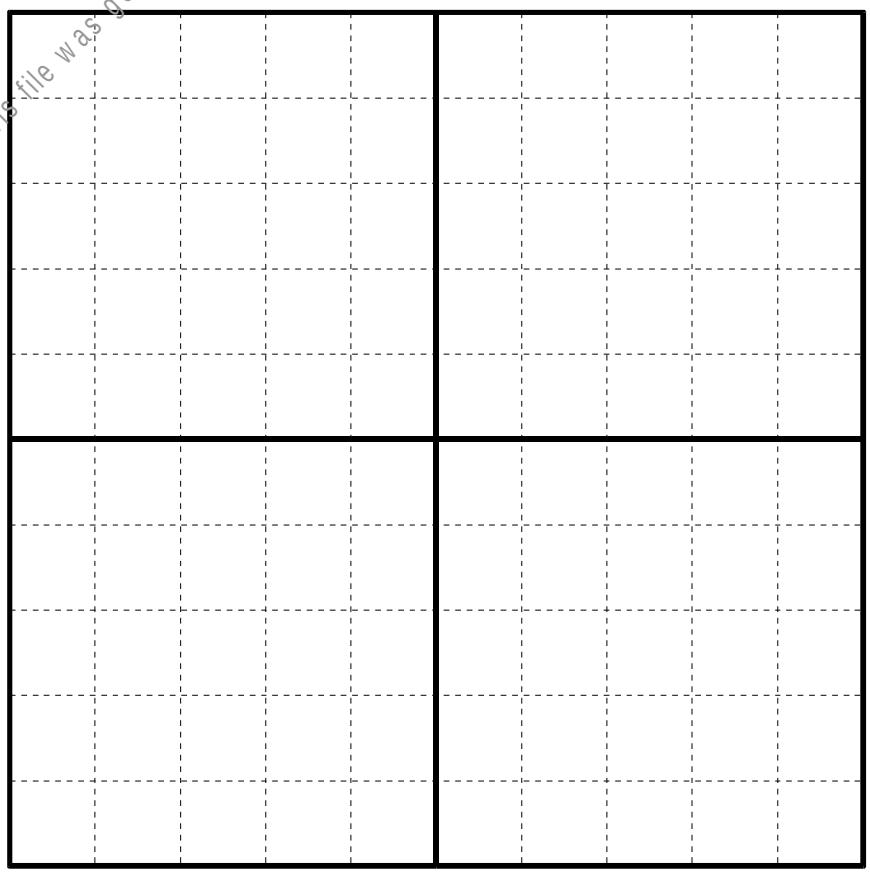
Question 4:

The input waveform shown below is used to drive the 2N2222 transistor circuit shown at right.



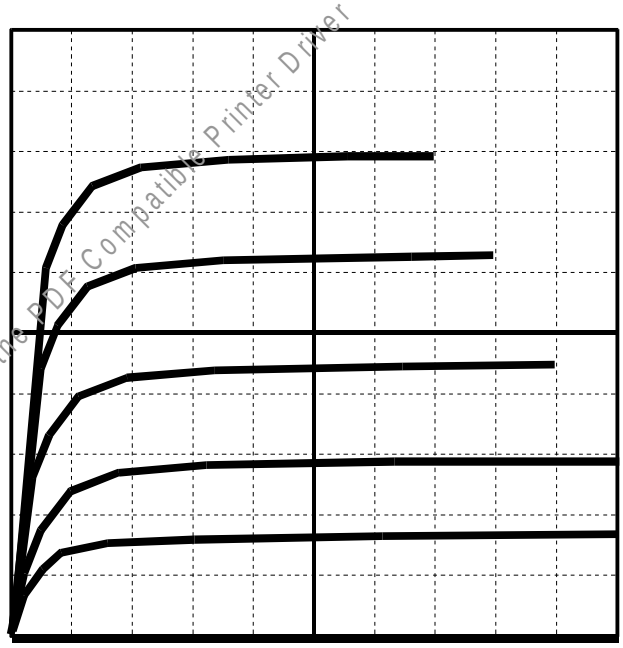


Two differential input attenuators are used to sense the voltages across the base (68K) and collector (1K) resistors and are connected to the 'X' and 'Y' inputs of an oscilloscope as shown. The oscilloscope is operating in "X-Y" mode, and the input sensitivity is set to display 1.0V / division for both the X and Y inputs. Assume that the transistor has a constant $\beta = 100$. Draw the expected oscilloscope display; be sure to identify all relevant points on the "oscilloscope display" below.



Question 5:

The Figure at right shows the display obtained from a "cure tracer" when connected to a 2N2907 PNP transistor. The collector current (vertical scale) is set to -2mA per division; the collector voltage setting (horizontal scale) is set to display -1V / division; the base step setting is 20μA.



i) Estimate β_{DC} at a collector current of 5mA.

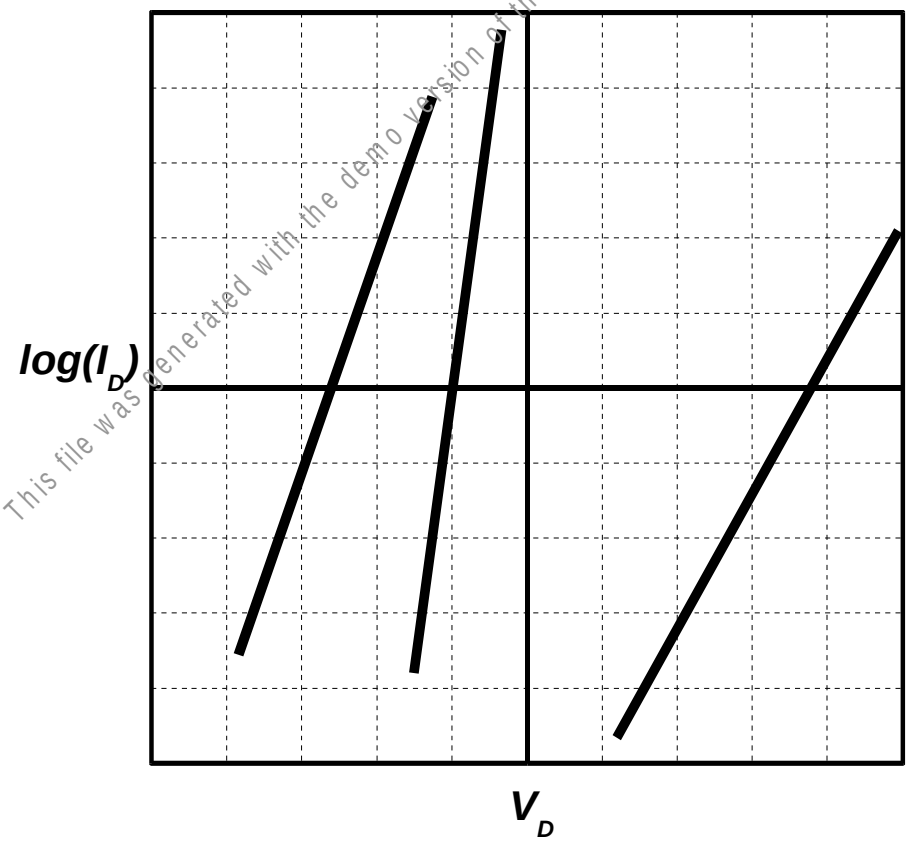
ii) Estimate β_{AC} for an input signal of $40\mu A_{0\text{-}P}$ if the transistor is biased at a collector current of approximately 10mA.

Question 6:

The graph below shows the forward voltage, V_F, and diode current, I_D, for three different types of diodes (note: the graph is semi-log – log(I) vs. V). The diode constant, n, for the three diodes is as follows:

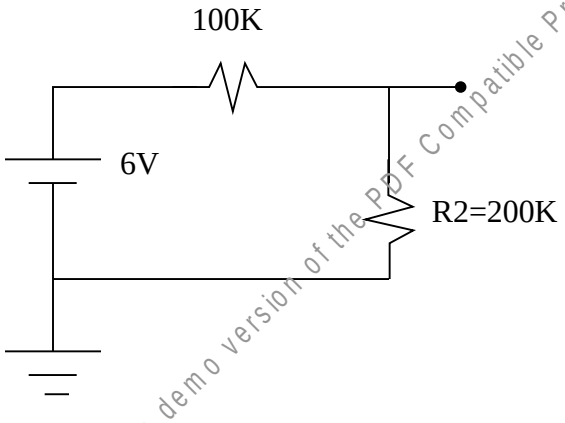
Diode #1: n = 0.88
Diode #2: n = 1.73
Diode #3: n = 2.60

Match the data shown on the graph below to the different diodes by labeling the graph accordingly (i.e. Diode #1, Diode #2 etc.).



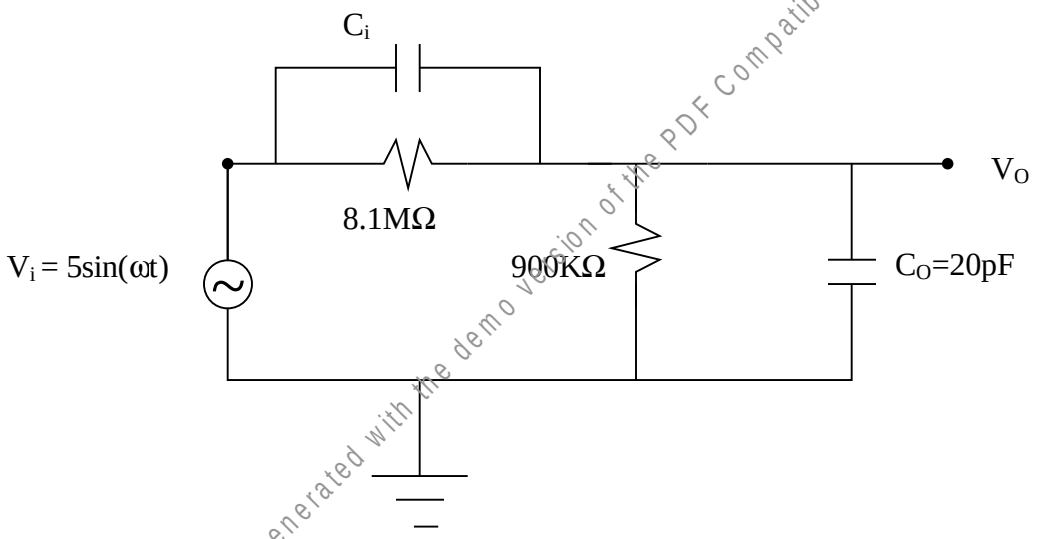
Question 7:

What is the voltage reading across R2 in the following circuit if the voltmeter has an impedance of 200KΩ.



Question 8:

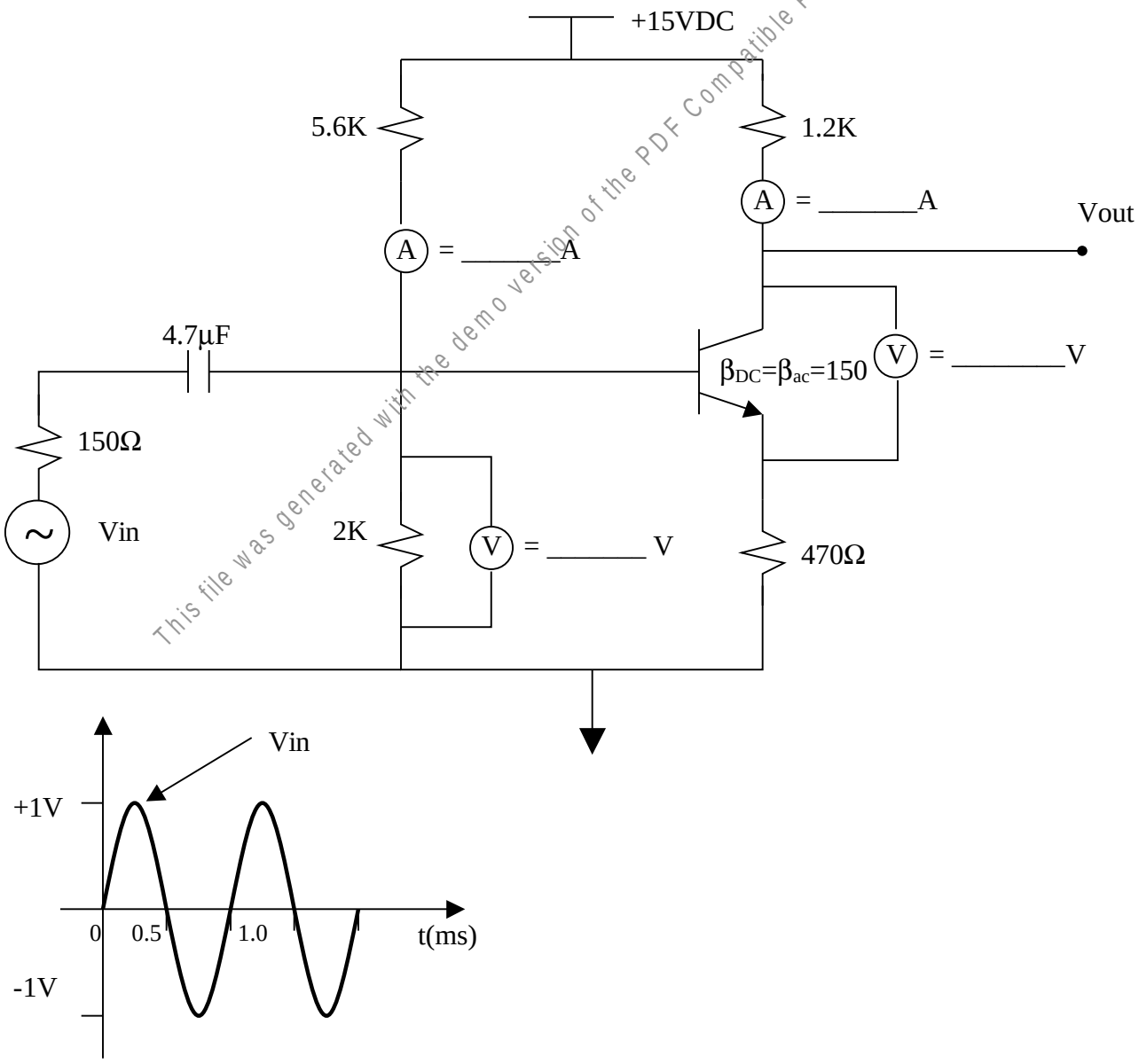
In the following circuit, find the voltage across the capacitor C_0 as a function of ω and C_i. Choose C_i so that for any given frequency, V_0 has a peak-to-peak voltage of 1V. What is the phase difference of V_0 and V_i at $\omega=10^3$ rad/sec?



Question 9:

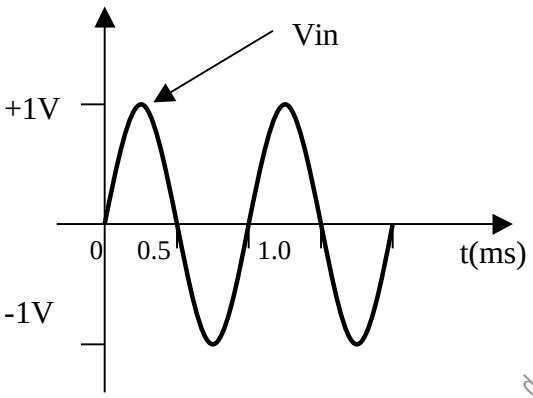
A CE amplifier has been set up in the lab as shown.

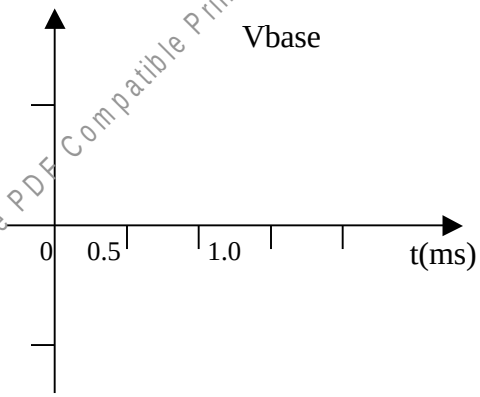
a) Fill in the DC voltage and DC current of the meters.

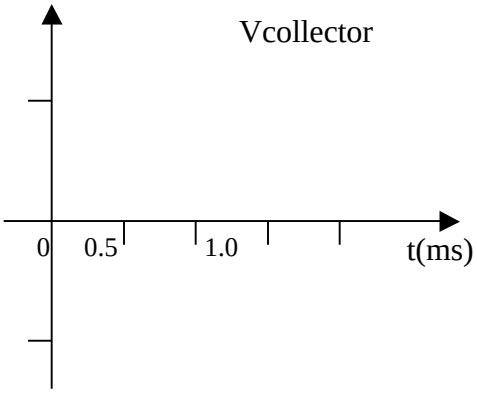


b) For the given waveform Vin of the signal generator, what is the amplifier gain (Vout/Vin)?

Sketch the waveforms (to scale) at the base and at the collector of the transistor with respect to ground.







c) Without changing DC bias of the transistor, modify the circuit to have an approximate voltage gain of 12 for the given input voltage. Show your modification and sketch the expected output waveform for the given input voltage at the signal generator.